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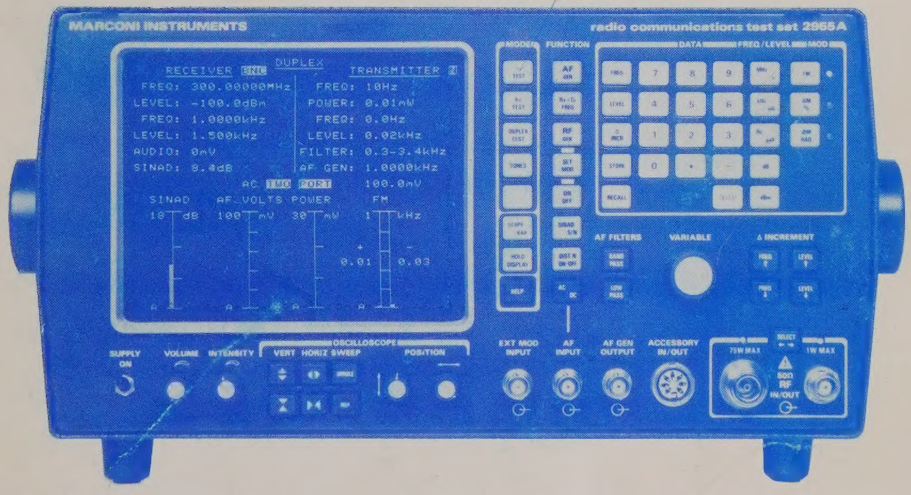
Marconi
Instruments

2955A and 2955R

RADIO COMMUNICATIONS TEST SETS



Programming Manual

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RADIO COMMUNICATIONS TEST SETS 2955A and 2955R

Part no. 52955-910L (2955A)
52955-911J (2955A without GPIB)
52955-321U (2955R)
52955-326F (2955A French)
52955-327G (2955A Spanish)
52955-328V (2955R French)
52955-329S (2955R Spanish)

This manual includes changes which were made in software version 8.

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ASSOCIATED PUBLICATIONS

	Part No.
Introductory Guide	... 46881-986A
Operating Manual, H 52955-910L, Vol. 1	... 46881-952B
Service Manual, H 52955-910L, Vol. 2	... 46881-954A

PREFACE

References to the 2955A also apply to the 2955R except in the table on p. 3–8.

AMENDMENT STATUS

Each page bears the date of its original issue or the date and number of the latest amendment. Any changes subsequent to the latest amendment are included on Manual Change sheets coded C1, C2 etc.

WARNINGS AND CAUTIONS

See the Operating Manual.

COMPATIBILITY WITH 2955

The 2955 has been superseded by the 2955A which has a number of improvements. If you are familiar with the 2955, you should beware of the differences in operation as follows:-

(1) On the 2955, the command code for the fifth blue MODE key is BC for BAR CHART. On the 2955A, the command code TM is used in place of BC as shown on Fig. 2-1. On the 2955A, command codes BC and SC are for the BAR CHART and SCOPE settings of the SCOPE/BAR key. If soft key codes XE or XF is used in 2955 software for this function, then these have to be changed to BC and SC for use with the 2955A.

(2) On the 2955, the command code for the fifth green FUNCTION key is MD for MOD ON-OFF. On the 2955A, the command code NF for ON OFF is used in place of MD but MD can still be used for compatibility with the 2955. This key is now used for RF and AF generators in addition to modulation.

(3) On the 2955, command RD25 is 'read sequential tone 12'. On the 2955A, command RD25 is 'read the sequential tone page number'. This is because there are now 3 pages of 11 tones each.

(4) Because of the improved tones/signalling capability, the 2955A has an extra menu for sequential tones. Therefore, add command code XB for SEQUENTIAL after TN for TONES. On the SEQUENTIAL TONES menus, XB to XF on the 2955 are changed to XA to XE on the 2955A.

(5) For self-testing on the 2955A, the user can decide to select NEXT TEST or ALL TESTS. Therefore, include command code XA for NEXT TEST or XF for ALL TESTS after the XF for SELF TEST.

(6) On the 2955, store 37 is used with a Cellular or Multi-system Adapter. On the 2955A, store 26 is used instead.

(7) Addresses for peek (PE) and poke (PO) are different. When these have been used, refer to a Marconi Instruments representative for new information.

(8) In the character generators, characters 10, 15, 16, 17, 27, 61 and 125 (decimal) are different to allow for enhanced displays. In the 2955 Operating Manual, see Fig. 3-17; in the 2955A Programming Manual, see Fig. 3-2.

Chapter 1

REMOTE CONTROL

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GPIB CONTROLLER

A 2955A can be remotely controlled (along with up to fourteen other devices) by means of a GPIB controller and suitable GPIB cabling.

The GPIB controller is a microcomputer with a GPIB interface circuit and with GPIB system software. At the keyboard, a high-level language (e.g. BASIC) is used. Commands for the 2955A are embedded in high-level statements. The controller converts these into the appropriate signals on the GPIB. The 2955A converts the GPIB signals back into its own commands.

The controller can be operated in immediate mode or programs can be saved and then loaded and run.

There is a wide range of controllers and details of operations. However, examples are given in Chap. 3 for a typical technical computer.

COMMANDS FOR THE 2955A

These take the form of a two-letter command code which is sometimes followed by numerical data. These are detailed in Chap. 2 and summarized in Appendix 1.

Delimiters are required to separate multiple data and multiple statements and to terminate the last command in a string.

The command codes perform different types of function as follows:-

(a) Normal functions of the keys on the front panel.

(b) Functions for which the MODE keys are used as soft keys.

(c) GPIB instructions which are not appropriate to manual operation.

(d) Requests for readings of measurements and settings which you would normally view on the screen.

SYNTAX

Conventions

The following conventions are used in this manual:-

Notation	Explanation	Example
AAAAAAAA	Items which are entered as a string.	TX
<AAAAAA>	ASCII control function which is entered as an ASCII code or ASCII character which is entered as a single key stroke.	<LF>
<aaaaaa>	Information as described which is to be entered as a string.	<data
[ ]	Entry of the enclosed item is optional.	[<data>]
...	The previous item(s) can be repeated as necessary.	<data><delimiter> ...

Delimiters

There are two types of delimiter as follows:-

(a) Low priority. <,> or <;> or <SPACE> or <CR>. These are used to separate fields within a statement. These can be omitted when ambiguity does not arise.

(b) High priority. <LF> (linefeed), <ETX> (end of text) or <ETB> (end of text block). These are used to separate adjacent statements and to terminate the last statement. (When required by the controller, the GPIB bus EOI line can be activated. See under EX in Chap. 2.)

COMMAND FORMAT

Commands take the following form:-

<command code> [<data>][<command code>][<delimiter>] ... <delimiter>

where <command code> is a 2-letter code as given in the Chap. 2

and <data> is an integer (NR1 format) or a fixed decimal point number (NR2 format). Exponential formats are not allowed.

Where there is more than one item of data, delimiters have to be used.

A typical command string (where the data items are separated by commas, the commands are delimited by semicolons and the string is terminated by <LF>) is as follows:-

RX;RG;FR123.5MZ;RD27;CS;WR0,0,TEST RESULT<LF>

Chapter 2

COMMAND CODES

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COMMAND CODES FOR KEYS

There is a command code for each of the normal functions of the keys on the front panel. Functions are as given in the Operating Manual except where otherwise stated. Some of these codes are followed by the data which is shown. See Table 2-1 and Fig. 2-1.

There is a command code for each of the functions for which the MODE keys are used as soft keys to select programmed functions from menus. Functions are as given in the Operating Manual. For some of the functions, there are alternative command codes so that they can be entered directly without the user needing to know the existing state. These command codes for direct entry are followed by the data which is shown. See Table 2-2 and Fig. 2-2. Where shown, some of the keys can be used at any time without selecting the normal menu.

OTHER COMMAND CODES

There are command codes for instructions which are sent on the GPIB and which are not appropriate to manual operation. See Table 2-3. Further explanations are given in Chap. 3.

There are command codes for measurements and settings which are sent on the GPIB. See Table 2-4. Further explanation is given in Chap. 3.

ASCII CODES

An ASCII character has been allocated to each key. When the command code SK is used, the character's ASCII code is sent on the GPIB. See Fig. 2-3.

TABLE 2-1 COMMAND CODES FOR NORMAL FUNCTIONS OF KEYS

Key group	Key legend	Function	Command code	Data
MODE and miscellaneous blue	TX TEST		TX	
	RX TEST		RX	
	DUPLEX TEST		DX	
	TONES		TN	
	TX MON ON-OFF	Off or on	TM	0 or 1
	SCOPE/BAR	BAR charts	BC	
		SCOPE	SC	
	HOLD DISPLAY	Off or on	HD	0 or 1
Brown	HELP		HP	
FUNCTION green	AF GEN		AG	
	RX=TX FREQ		RT	
	RF GEN		RG	
	SET MOD		SM	
	ON OFF	Off or on	NF	0 or 1
		All modulation off or modulation 1 and external modulation on (for compatibility with 2955 MOD ON-OFF)	MD	0 or 1
	SINAD S/N and DIST'N ON-OFF	Off, DEFAULT NOISE READING (as under PARAMETERS), non-default reading or DISTORTION	SN	0, 1, 2 or 3
Brown	AC DC	AC	AC	
		DC	DC	
DATA orange	FREQ		FR	
	LEVEL		LV	
	Δ INCR		DI	
	STORE		ST	
	RECALL		RC	
DATA white	Numerical		As key	
	DELETE		DE	
FREQ/LEVEL orange	MHz V	MHz	MZ	
		V	VL	
	kHz mV	kHz	KZ	
		mV	MV	
	Hz μV	Hz	HZ	
		μV	UV	
	dB	dB	DB	
		dBμV	BU	
	dBm		DM	

Key group	Key legend	Function	Command code	Data
MOD orange	FM		FM	
	AM %		AM	
	ΦM RAD		PM	
Δ INCREMENT brown	FREQ ↑		FU	
	FREQ ↓		FD	
	LEVEL ↑		LU	
	LEVEL ↓		LD	
AF FILTERS brown	BAND PASS and LOW PASS	0.3 to 3.4 kHz, 15/50 kHz, 300 Hz or external	FI	0, 1, 2 or 3
OSCILLOSCOPE brown	SINGLE		SW	
	REP		RP	
	◀▶		TD	
	▶◀		TU	
	▲▼		VD	
	▼▲		VU	
Brown	SELECT ←→	BNC RF IN/OUT, N RF IN/OUT or one-port duplex	IP	0, 1 or 2

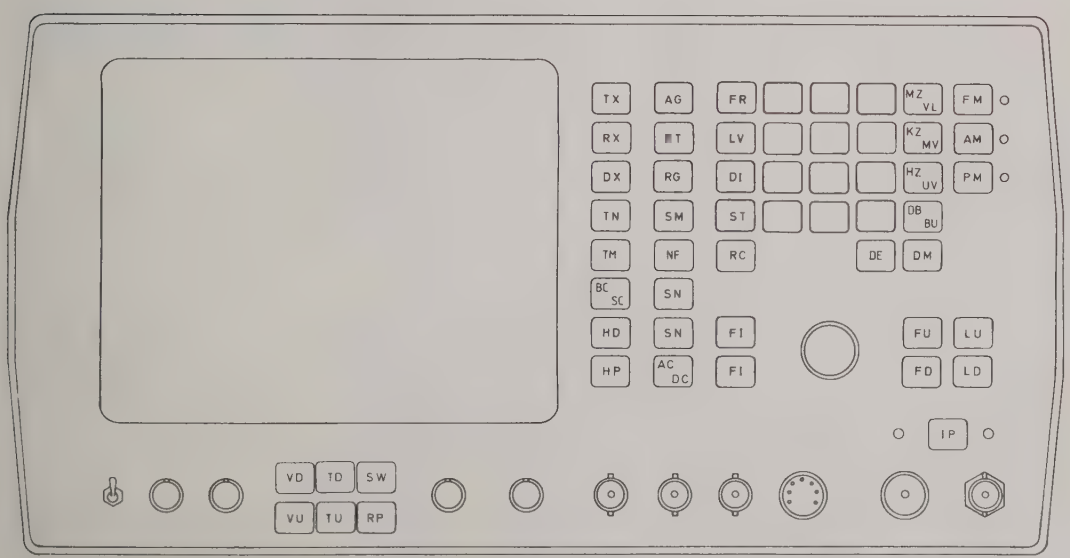

Fig. 2–1 Command codes for normal functions of keys

TABLE 2-2 COMMAND CODES FOR SOFT-KEY FUNCTIONS

Menus or displays	Function	Command code		
		Normal	Direct	
			Code	Data
TONES	AUDIO SETUP	XA		
	MOD SETUP	XA		
	MOD or AF SETUP	XA		
	SEQUENTIAL	XB		
	SEQUENTIAL ENCODE	XB		
	DTMF	XC		
	DCS	XD		
	SEQUENTIAL DECODE	XD		
	POCSAG	XE		
	RETURN	XG		
TX AUDIO SETUP	LOCK or UN-LOCK	XE	LL	1 or 0
RX MODULATION SETUP	SHAPE	XF	WS	0 (SINE), 1 (SQUARE), 2 (TRIANGLE), or 3 (SAW TOOTH)
	RETURN	XG		
	EXT MOD or OFF	XH		
SEQUENTIAL TONES	CCIR	XA		
	ZVEI	XB		
	DZVEI	XC		
	EEA	XD		
	EIA	XD		
	USER DEFINED	XE		
	REVERTIVE	XF		
	RETURN	XG		
TX SEQUENTIAL TONES	NEXT PAGE	XB		
	RESET or READY	XC		
	RETURN	XG		
RX SEQUENTIAL TONES AF SEQUENTIAL TONES	NEXT PAGE	XA		
	NEXT TONE	XB		
	TONE BURST	XC		
	CONTINUOUS or TONES STOP	XD		
	TONE STEP	XE		
	FREQ SHIFT	XF		
	RETURN	XG		
	EXTEND or CANCEL E	XH		
USER DEFINED STANDARD	NEXT TONE	XB		
	DURATION	XD		
	ms	XE		
	CONTINUE	XF		
	RETURN	XG		

Menus or displays	Function	Command code		
		Normal	Direct	
			Code	Data
RX REVERTIVE SEQUENTIAL TONES menu	POWER	XB		
	SEND STANDARD	XC		
	RECEIVE STANDARD	XD		
	CONTINUE	XF		
	RETURN	XG		
RX REVERTIVE SEQUENTIAL TONES display	NEXT TONE	XB		
	SEND	XC		
	CONTINUE	XF		
	RETURN	XG		
	EXTEND or CANCEL E	XH		
DTMF GENERATOR AND DECODER	Send single digits	As key	OD	0 to F
	SEND	XB	SS	
	CLEAR SEND DATA	XC	CT	
	CLEAR RECEIVE DATA	XD	CD	
	LOAD	XE	LS	
	TONE DURATION	XC		
	ms	XD		
	GAP DURATION	XE		
	RETURN	XG		
	PAGE 2 or 1	XH		
DCS DECODER DCS GENERATOR	SEND or STOP	XB		
	POLARITY	XC		
	CODE or ENTER	XD		
	RETURN	XG		
POCSAG RADIO PAGER TEST	INVERT OR NORMAL	XA		
	SEND	XB		
	RIC or ENTER	XC	RI	7 digits
	ERRORS or CHANGE	XD		
	Create		PP	1 to 32
	Delete		PT	1 to 32
	ADDRESS	XF	PA	1, 2, 3 or 4
	RETURN	XG		
	MESSAGE	XH	PS	1, 2, 3 (all languages) or 4 (English only)
HELP	TRANSMITTER TESTING	XA		
	RECEIVER TESTING	XB		
	DUPLEX TEST	XC		
	AUDIO TESTING	XD		
	CHANGE PARAMETERS	XE		
	SELF TEST	XF		
	RETURN	XG		

Menus or displays	Function	Command code		
		Normal	Direct	
			Code	Data
PARAMETERS (Any menu for direct codes)	RF LEVEL			
	EMF or PD	XA	EM or PD	
	STORE FUNCTION			
	ON or OFF	XB	SE or SD	
	RF COUNTER RESOLUTION			
	1 Hz or 10 Hz	XC		
	DEFAULT NOISE READING			
	S/N or SINAD	XD		
	600 Ω BALANCED AF ACCESSORY			
	FITTED or NOT FITTED	XE		
	20 dB AF ATTENUATOR ACCESSORY			
	FITTED or NOT FITTED	XF		
	DEFAULT AF FILTER			
	0.3 - 3.4 kHz BP, 15/50 kHz LP or 300 Hz LP	XA		
	DEFAULT MOD LEVEL	XB		
	RX/TX MOD TYPE LOCK			
	ON or OFF	XC		
	TONE STANDARD			
	EUROPEAN or USA	XD		
	RF LEVEL OFFSET	XE		
	GPIB MODE			
	NORMAL or 2955 EMULATION	XF	CM	0 or 1
	RETURN	XG		
	PAGE 2 or 1	XH		
TRANSMITTER MONITOR	RF IMAGE			
	UPPER or LOWER	XB	IM	1 or 0
	IF FILTER			
	12 or 180 kHz	XC	IF	0 or 1
	RETURN	XE		
	LCL	XH		
DIRECTIONAL POWER METER (Any menu for direct codes)	PEP or CW	XC	PR or CR	
	LCL	XH		
TRANSMITTER TEST RECEIVER TEST DUPLEX TEST AUDIO TEST	LCL	XH		

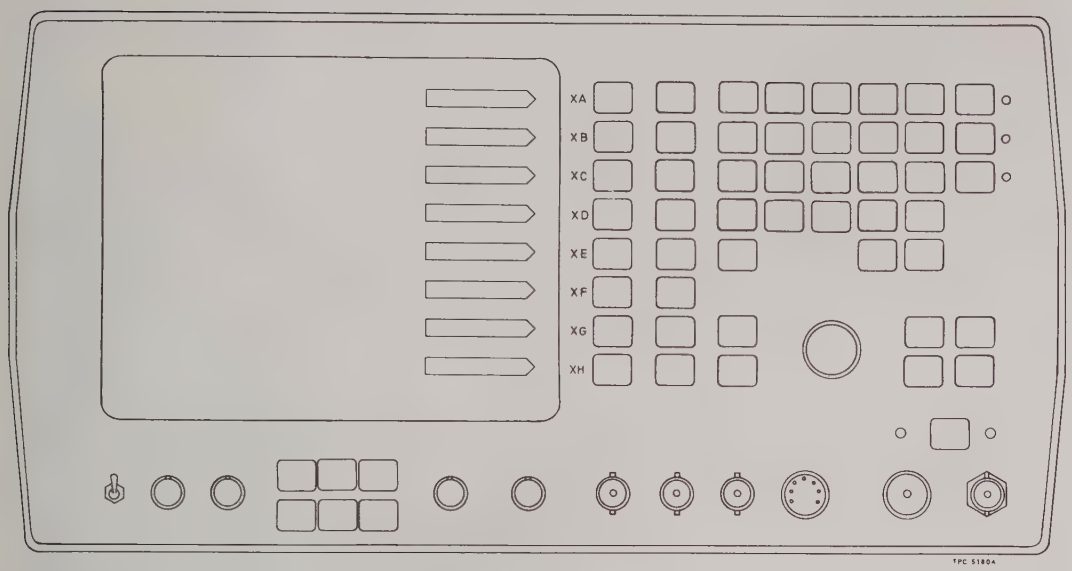

Fig. 2–2 Command codes for soft–key functions

TABLE 2–3 COMMAND CODES FOR GPIB INSTRUCTIONS

Function	Command code	Data
DIRECTIONAL POWER METER display disable when Directional Power Head is fitted	DT	
DIRECTIONAL POWER METER display enable when Directional Power Head is fitted	ET	
Output buffer purge (clears data available flag but service request flag remains raised)	PG	
Output from 2955A with letters of mixed case in units (e.g. dBm) (default condition which suits most printers)	LC	
Output from 2955A with all letters of upper case in units (e.g. DBM)	UC	
Output from 2955A having <CR><LF> between readings and <LF> with the GPIB's EOI line true when the output buffer is empty (default condition which suits most controllers)	LF	
Output from 2955A having <CR><LF> with the GPIB's EOI line true between readings and <ETX> with the GPIB's EOI line true when the output buffer is empty	EX	

Function	Command code	Data
Poke byte <n> into memory location <m> (includes a 10 ms delay for EEPROMs) (Data cannot be poked to the display since it is not memory mapped - use WR.)	PO	<m>, <n>
Poke bytes <n1>, <n2> etc (up to a terminator) into memory locations starting at <m> (maximum of 64 bytes) (includes a 10 ms delay for EEPROMs) (These should not be used except under the supervision of a Marconi Instruments representative.)	DU	<m>, <n1>, <n2> ...
Screen clear	CS	
Screen output disable	DS	
Screen output enable	ES	
Screen restore	RS	
On screen, suppress reverse video REM, ADR and SRQ and soft key legend LCL (This is cleared by RS.)	SP	
On screen, draw soft key box to arrow the key where <n> is the box position and <m> is the box length (number of characters).	BX	<n>, <m>
On screen, write <string> starting at given column and given row (This is followed by delimiter <ETB> <ETX> or <LF>. <CR> has the effect of <CR><LF>.)	WR	0 to 39, 0 to 31, <string>
Service request inhibit (default), error only or enable	SQ	0, 1 or 2
SEQUENTIAL TONES, select FREQUENCY measurements for use with RD 14 to 24 (Table 2-4)	TF	
SEQUENTIAL TONES, select TONE number and ERROR measurements for use with RD 14 to 24 (Table 2-4)	TE	
Sound a tone in the loudspeaker (The loudness is determined by the VOLUME control setting.)	BP or PB	
VARIABLE control disable	DV	
VARIABLE control enable	EV	

TABLE 2-4 COMMAND CODES FOR GPIB READINGS

Function	Command code	Data
Send (when next addressed to talk) the measurement or setting as specified in <n> as follows:-	RD	<n>
AF counter FREQUENCY measurement		5
AF GENERATOR FREQUENCY INCREMENT setting		35
AF GENERATOR FREQUENCY setting		29
AF GENERATOR LEVEL INCREMENT setting		36
AF GENERATOR LEVEL setting		30
AF GENERATOR 2 FREQUENCY setting		100
AF GENERATOR 2 LEVEL setting		101
AF LEVEL measurement in dBV or dBr		104
AF LEVEL voltage measurement		6
DIRECTIONAL POWER METER FORWARD POWER measurement		11
DIRECTIONAL POWER METER REVERSE POWER measurement		12
DIRECTIONAL POWER METER VSWR measurement		13
DTMF RECEIVE DATA		109
MODULATION FREQUENCY INCREMENT setting		37
MODULATION FREQUENCY measurement		3
MODULATION FREQUENCY setting		31
MODULATION LEVEL default setting		106
MODULATION LEVEL INCREMENT setting		38
MODULATION LEVEL measurement in dB		105
MODULATION LEVEL voltage measurement		4
MODULATION LEVEL setting		32
MODULATION LEVEL peak positive measurement		9
MODULATION LEVEL trough negative measurement		10
MODULATION 2 FREQUENCY setting		102
MODULATION 2 LEVEL setting		103
POCSAG RIC setting		108
RECEIVER SINAD, S/N or DISTORTION measurement		7
RF counter FREQUENCY measurement		1
RF GENERATOR FREQUENCY INCREMENT setting		33
RF GENERATOR FREQUENCY setting		27
RF GENERATOR LEVEL INCREMENT setting		34
RF GENERATOR LEVEL setting		28
RF POWER measurement in W or dBm		2
SEQUENTIAL TONES DURATION in ms setting		107
SEQUENTIAL TONES, current PAGE number		25
SEQUENTIAL TONES, standard setting		26
SEQUENTIAL TONES, TONE 1) FREQUENCY measurement		14
SEQUENTIAL TONES, TONE 2) or TONE number and		15
SEQUENTIAL TONES, TONE 3) ERROR measurement as		16
SEQUENTIAL TONES, TONE 4) determined by using		17
SEQUENTIAL TONES, TONE 5) TF or TE		18
SEQUENTIAL TONES, TONE 6) (Table 2-3)		19
SEQUENTIAL TONES, TONE 7)		20
SEQUENTIAL TONES, TONE 8)		21
SEQUENTIAL TONES, TONE 9)		22
SEQUENTIAL TONES, TONE 10)		23
SEQUENTIAL TONES, TONE 11)		24
SQUELCH status (0 for demodulation meter outputs disabled, 1 for demodulation meter outputs enabled)		110
TRANSMITTER SINAD, S/N or DISTORTION measurement		8

Function	Command code	Data
	RD	<n>
Whole page of measurements and settings (TRANSMITTER TEST, RECEIVER TEST and DUPLEX tests only)		39
Send (when next addressed to talk) an ASCII code for the character of the last key pressed - see Fig. 2-3	SK	
Send (when next addressed to talk) the code for the last error detected	ER	
Send (when next addressed to talk) the data at memory location <m> (This should not be used except under the supervision of a Marconi Instruments representative.)	PE	<m>
Send (when next addressed to talk) a data string which, when sent back to the instrument, restores current settings	SV	
Send (when next addressed to talk) the software version number (A 2955A is distinguished from a 2955 by having a version number above 100.)	VN	

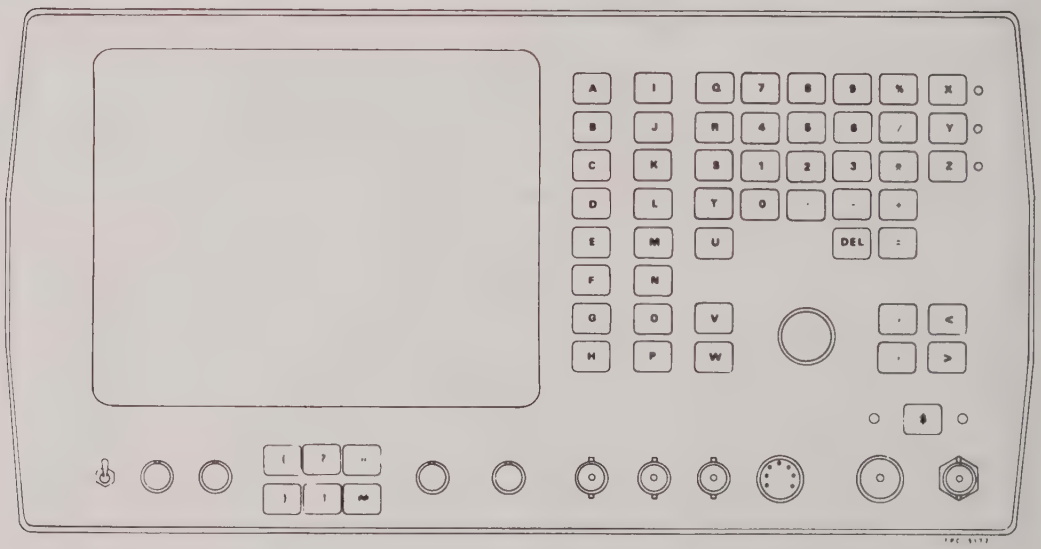

Fig. 2-3 ASCII characters sent when the SK command code is used

Chapter 3

WRITING A PROGRAM

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OPERATING EXAMPLE

RX;RG;FR123.5MZ;DI100KZ;LV-30DM;SM;FR1KZ;LV50AM;NF1;AC;SN2<LF>
is an example of a composite statement which has the following meaning:-

Statement	Key equivalent	Explanation
RX;	RX TEST	In RECEIVER TEST mode,
RG;	RF GEN	set the RF generator
FR	FREQ	frequency
123.5MZ;	125.5 MHz	to 123.5 MHz,
DI	Δ INCR	set the increment
100KZ;	100 kHz	to 100 kHz,
LV	LEVEL	set the RF level
-30DM;	-30 dBm	to -30 dBm,
SM;	SET MOD	set the modulation
FR	FREQ	frequency
1KZ;	1 kHz	to 1 kHz,
LV	LEVEL	set the modulation level
50AM;	50 AM %	to 50% AM and,
NF1;	ON OFF	with modulation on,
AC;	AC DC	set to AC coupling and
SN2	SINAD S/N	measure signal to noise
<LF>		

The above example is equivalent to a normal sequence of keys except as follows:-

(a) NF1 is a direct entry without knowing the existing state.

(b) AC is a direct entry without knowing the existing state.

(c) SN2 is a direct entry on the assumption that SINAD is the DEFAULT NOISE READING selection under PARAMETERS.

CONTROLLER PROGRAMS

On the controller, set the 2955A to remote control and enter 2955A commands within quotation marks (e.g. OUTPUT 706;"RX" <LF>). In this example, the number indicates the controller's GPIB port (i.e. 7) and the 2955A's address (i.e. 06). REM and ADR appear in reverse video on high-level displays. Also, the soft key arrow LCL (local) appears.

To return to local manual control, press the LCL key.

On the controller, you can request data from the 2955A when it has completed measurements or for any other reason (e.g. ENTER 706;A$ <LF> and say PRINT A$ <LF>).

COMMAND INPUT

If the 2955A detects a syntax error, then that command and all subsequent commands up to the next low-priority delimiter are aborted and an error is raised.

The 2955A's input buffer length is 128 characters. If the buffer becomes full, then the GPIB is held off until further space is available. However, if the buffer does not contain a command delimiter, then the data is lost and an error is raised. This is because command interpretation, and hence buffer unloading, does not occur until a command string delimiter is received.

DATA OUTPUT

Every request for data causes a response from the instrument. This takes the following form:-

<data> [<data type>] <delimiter>

where <data> contains the reading

and <data type> is an ASCII string when the data requires qualifying (e.g. MHz and dBm).

The data may be a numerical or alpha string. There is no fixed format except that numerical data conforms to NR1 or NR2 data types (i.e. non-exponential).

All readings are terminated with <LF>. The GPIB bus EOI line is sent true when the output buffer is empty.

If no data is available, the default response is NULL.

Certain commands cause the instrument to output more data than it can store in its output buffer (e.g. SV and RD39). The result is that the data is held off from entering the buffer and hence the instrument stops. To prevent locking up the instrument, a 2 second timeout takes effect. If data output has not been started or is read out slower than 1 character per 2 seconds, then a buffer overflow error is raised and the instrument aborts the command.

STATUS BYTE AND SERVICE REQUESTS

In the instrument, there is one status byte which contains the following bits:-

Byte	Function
1xxxxxxx	Data ready
x1xxxxxx	Service request
xx1xxxxx	An error bit is high
xxx1xxxx	Numerical entry error (error bit 4)
xxxx1xxx	Data error (error bit 3)
xxxxx1xx	Abnormal operation (error bit 2)
xxxxxx1x	Syntax error (error bit 1)
xxxxxxx1	Input/output buffer overflow (error bit 0)

When the 2955A's service request is enabled by means of SQ1 or SQ2, it can send the status byte when the controller takes a serial poll (e.g. SPOLL (706) <LF>). After SQ1, the service request bit is high only when an error bit is high. After SQ2, the service request bit is high when an error bit or the data ready bit is high.

When the service request bit is high, SRQ appears in reverse video on high-level displays and the GPIB's SRQ line is true.

The data ready and error bits are cleared the next time the instrument is addressed to talk. The service request bit is cleared after a serial poll.

CREATING A SCREEN DISPLAY

A GPIB controller can be used to create your own form of screen display. The 2955A has a number of screen commands and it has a comprehensive character set stored in memory.

Screen commands

Using the command codes which are listed in Table 2-3, create your own display as follows:-

(a) Use CS to clear the current display from the screen.

(b) Use WR and BX to define your own display.

When CS is used, measurements remain on the screen. Use DS to stop measurements (disable) from being shown on the screen and use ES to write measurements (enable) on the screen.

WR (WRite) commands

These are used to write characters on the screen display. The command code WR is followed by the start location and then the characters which are to be written.

The start address takes the form <c>,<r>, where <c> is the column number and the <r> is the row number as shown on the worksheet which is given in Fig. 3–1. This can be copied and used for plotting.

Anything immediately following WR<c>,<r>, is treated as a literal until a high–priority delimiter is seen. Thus, when there is more than one WR command in a statement, end each with <LF>, <CR> (moving the cursor to the beginning of the next line), <ETB> or <ETX> (e.g. WR20,15,A <LF> WR20,16,B <LF>) and do not only insert a delimiter at the end (e.g. not WR20,15,A,WR,20,16,B<LF>). In a controller statement, CHR$(10) would be used for <LF>
(e.g. OUTPUT706;"WR20,15,A";CHR$(10);"WR20,16,B";CHR$(10)).

Character set

For the complete set of characters for the instrument, see Table 3–1 and Fig. 3–2. These characters are used with the WR command to write onto the screen display. In addition to alphanumerical characters A to Z and 0 to 9, there are elements to make graphics, oscilloscope graticules and bar charts.

With the principal exception of the alphanumerical characters A to Z and 0 to 9, the characters are non–ASCII. There are two ways to enter non–ASCII characters – either use the code or enter the ASCII equivalent (e.g. for kΩ, use "WR10,10,";CHR$(41);CHR$(38) or "WR10,10,)&"). When a lower case letter (ASCII) is sent from the controller, it is interpreted by the 2955A as a reverse video upper–case letter.

For codes 3, 10, 13 and 23, blanks are shown on Fig. 3–2. These codes are for <ETX>, <LF>, <CR> and <ETB>. As codes 3 and 10 are not available for reverse video 0 and 7, codes 2 and 19 are used instead. A reverse video z can be seen on the CHANGE PARAMETERS menu but it is only available to internal software and not from the GPIB.

Table 3–1 and Fig. 3–2 are for normal operation. For 2955 emulation, there is one difference – the character for code 125 (reverse video /) is not as shown but is the same as the box element for code 63.

Reverse video characters

For characters which have a bar at the top (i.e. E, F, T and Z), a better appearance can be given by writing a reverse video top character (code 59) directly above it (e.g "WR10,15,e" for a reverse video E with "WR10,14,";CHR$(59) or "WR10,14,;" for a reverse video top character).

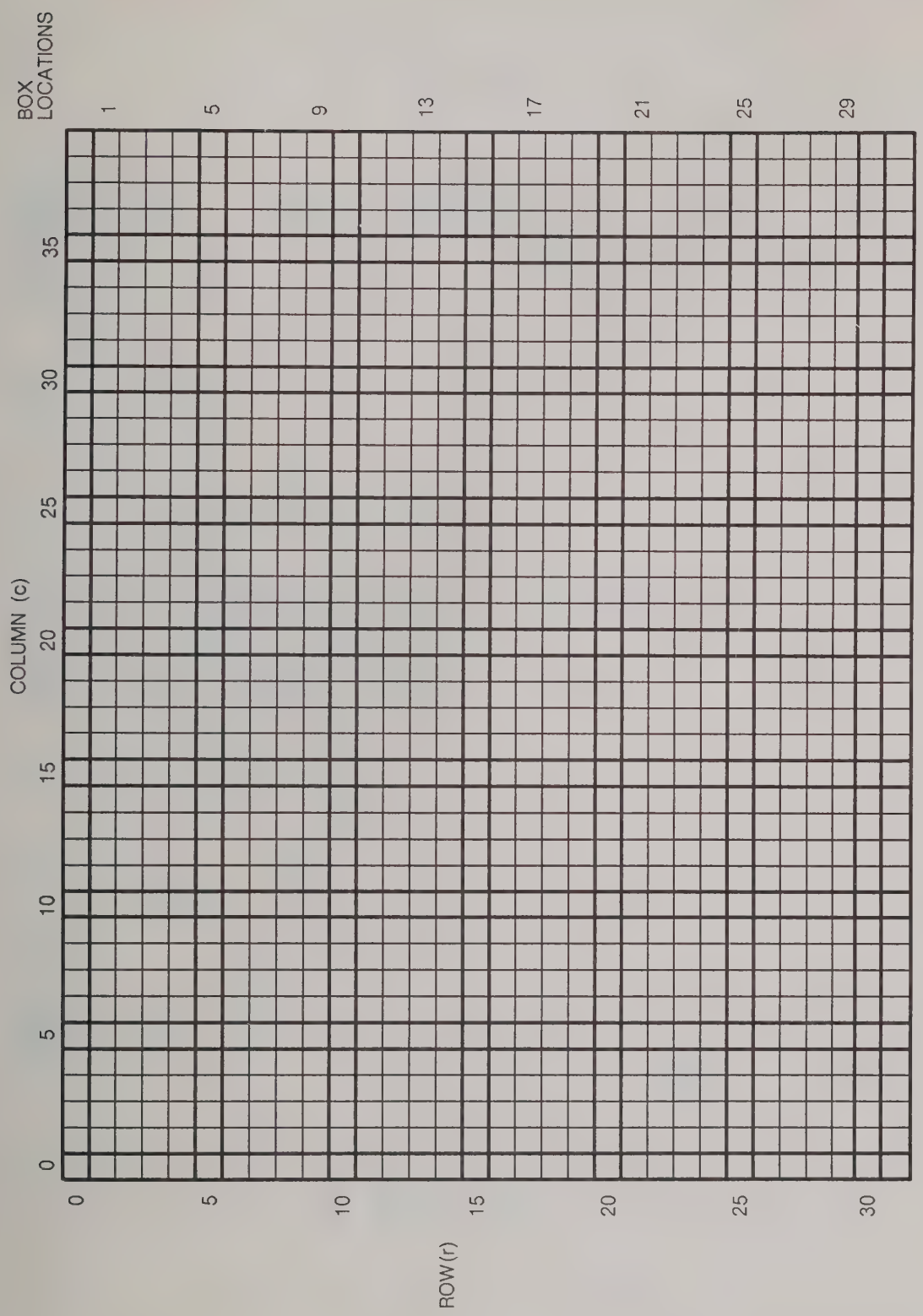


Fig. 3–1 Screen address worksheet

TABLE 3-1 CHARACTER CODES

Code		2955A character	ASCII
dec	hex		
0	0	- (Reverse video)	
1	1	. (Reverse video)	
2	2	0 (Reverse video)	
3	3	<ETX>	<ETX>
4	4	1	
to	to	to	
9	9	6 (Reverse video)	
10	A	<LF>	<LF>
11	B	8 (Reverse video)	
12	C	9 (Reverse video)	
13	D	<CR>	<CR>
14	E	Arrow symbol	
15	F	* (Reverse video)	
16	10	Ω (Reverse video)	
17	11	# (Reverse video)	
18	12	*	
19	13	7 (Reverse video)	
20	14	$	
21	15	#	
22	16	Bell symbol	
23	17	<ETB>	<ETB>
24	18	?	
25	19	@	
26	1A	Copyright symbol	
27	1B	Graphics element	
28	1C	<	
29	1D	[	
30	1E	]	
31	1F	Space (Reverse video)	
32	20	Space	Space
33	21	s	!
34	22	z	"
35	23	_ (Underline)	#
36	24	µ	$
37	25	%	%
38	26	Ω	&
39	27	m	´
40	28	d	(
41	29	k	)
42	2A	Φ	*
43	2B	+	+
44	2C	,	,
45	2D	-	-
46	2E	.	.
47	2F	/	/

Code		2955A character	ASCII
dec	hex		
48	30	0	0
to	to	to	to
57	39	9	9
58	3A	:	:
59	3B	Reverse video top	;
60	3C	Graphics element	<
61	3D	´	=
62	3E	Graphics element	>
63	3F	Graphics element	?
64	40	Graphics element	@
65	41	A	A
to	to	to	to
90	5A	Z	Z
91	5B	Graphics element	[
92	5C	Graphics element	\
93	5D	>	]
94	5E	Graphics element	^
95	5F	Graphics element	_
96	60	Pointer symbol	´
97	61	A	a
to	to	to	to
122	7A	Z (Reverse video)	z
123	7B	Graphics element	{
124	7C	Graphics element	|
125	7D	/ (Reverse video)	
126	7E	↓	-
127	7F	↑	
128	80		
to	to		
191	BF	Graticule elements	
192	C0	Graphics element (Flashing)	
193	C1	A	
to	to	to	
218	DA	Z (Flashing)	
219	DB		
to	to		
223	DF	Graphics elements (Flashing)	
224	E0		
to	to		
255	FF	Bar chart elements	

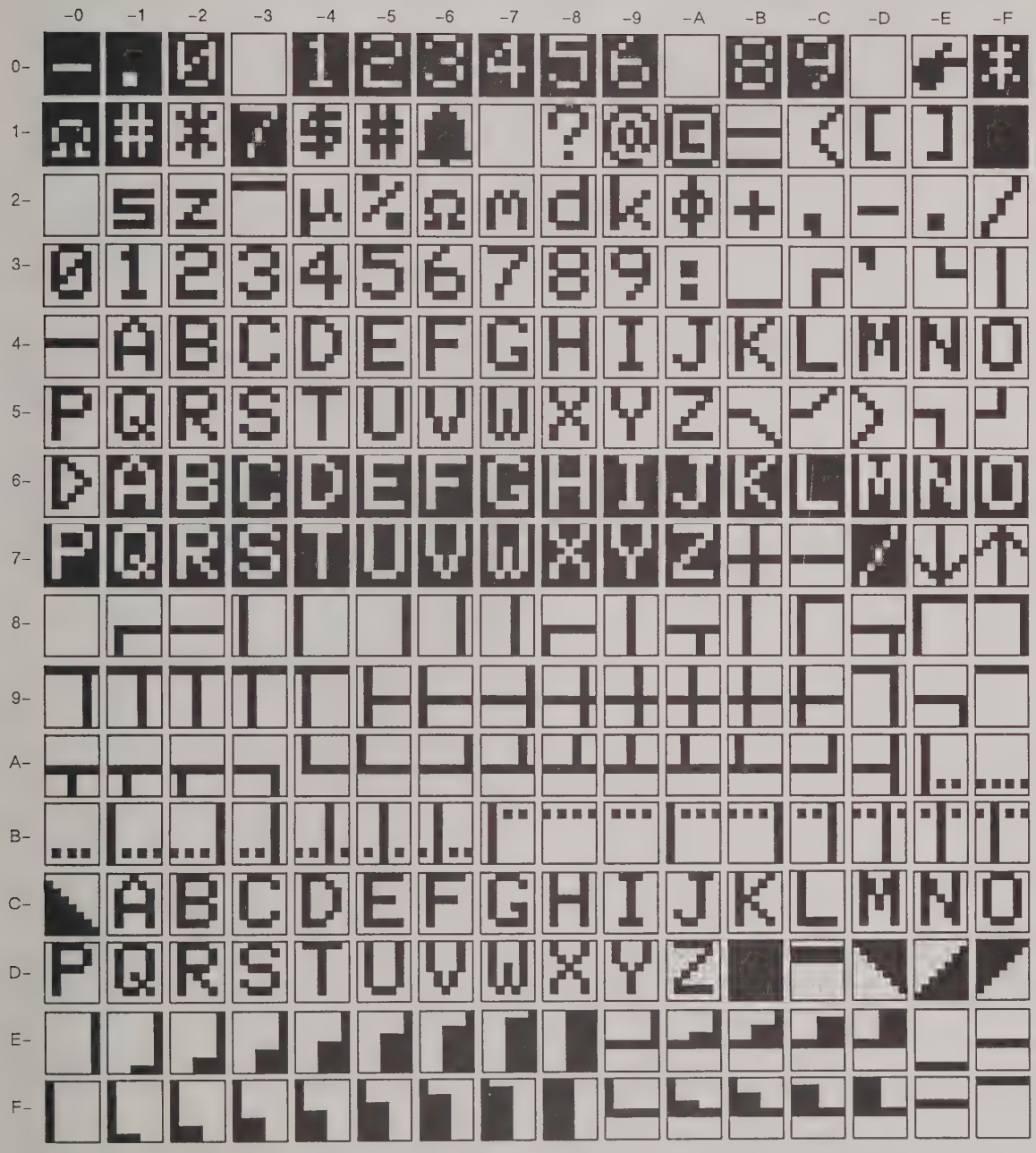


Fig. 3–2 Character set for 2955A

Graticule elements

There are sixty-four graticule elements for oscilloscope displays (codes 128 to 191).

When two or more graticule elements are adjacent in a vertical line, the oscilloscope trace is automatically enabled. Enabling starts from half-way down the top element to half-way down the bottom element. The oscilloscope trace is not enabled for a single element or for alternate elements in a vertical line. For a space with the trace enabled, it is necessary to use code 128 and not code 32.

If these elements are used for other purposes in a user-defined display, the oscilloscope trace could cause peculiar effects. To detect the presence of a trace, check for any movement while adjusting the POSITION controls.

BX (BoX) commands

These are used to draw arrowed boxes for the functions of soft keys. The command code BX is followed by data <n> and <m>.

The box positions data <n> is the decimal equivalent of the 8-digit binary number which indicates by 1 or 0 which of the eight keys have a box or no box alongside. The eight bits (reading left to right) are for the boxes in rows 29, 25, 21, 17, 13, 9, 5 and 1 respectively. Thus, for a box or no box alongside each key, <n> is the sum of the following decimal data:-

Row	Key	Decimal data
1	TX TEST	1 or 0
5	RX TEST	2 or 0
9	DUPLEX TEST	4 or 0
13	TONES	8 or 0
17	Unmarked (2955A)	
	TX MON ON-OFF (2955R)	16 or 0
21	SCOPE/BAR	32 or 0
25	HOLD DISPLAY	64 or 0
29	HELP	128 or 0

The length data <m> is the maximum number of characters in the box. The actual total length is 3 more than this - 1 for the left side and 2 for the arrow. When boxes of different lengths are required, sequential BX commands have to be sent.

Thus, to display SELECT in a box of total length 10 alongside the SCOPE/BAR key, use BX32,7;WR31,21,SELECT<LF>).

Since CONTINUE and RETURN are commonly used for menu displays, the facility exists to call up these labels directly by adding fixed values to <m>. The positions for these are fixed - CONTINUE alongside the SCOPE/BAR key and RETURN alongside the HOLD DISPLAY key). This replaces a WR command.

To call up the CONTINUE box, add 32 to <m>. Ensure that there is sufficient room for the word in the box (i.e. 32 + ≥8 = ≥40), otherwise CONTINUE cannot be included. Thus, to display CONTINUE in a box of total length 11 alongside the SCOPE/BAR key, the command is BX32,40<LF>.

To call up the RETURN box, add 128 to <m>. Ensure that there is sufficient room for the word in the box (i.e. 128 + ≥6 = ≥134), otherwise RETURN cannot be included. Thus, to display RETURN in a box of total length 9 alongside the HOLD DISPLAY key, the command is BX64,134<LF>.

To clear the screen prior to the boxes being displayed, add 64 to <m>.

User-defined display examples

To write a reverse video A at the centre of the screen at column 20, row 15, use "WR20,15,";CHR$(97) or "WR20,15,a". To write SELECT in the box alongside the SCOPE/BAR key, use BX32,6;WR32,21,SELECT<LF>. See Fig. 3-3.

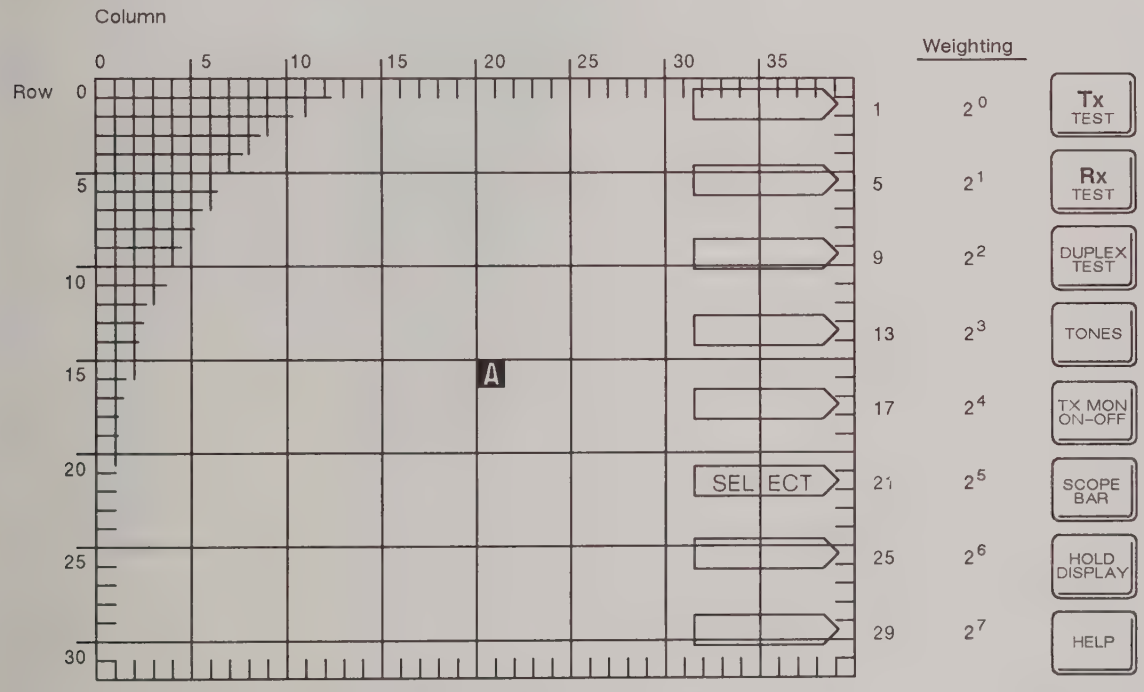
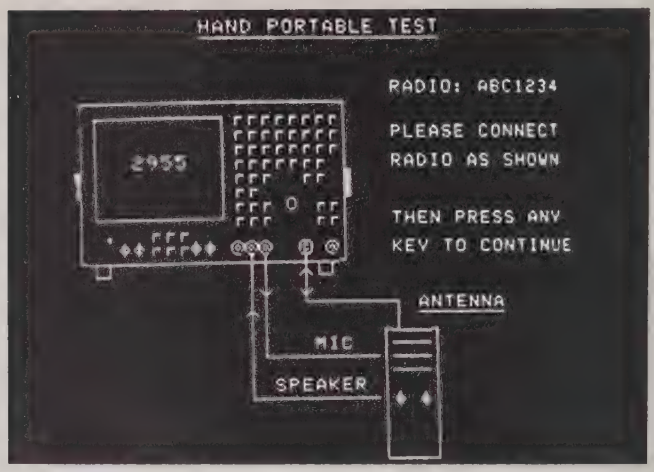


Fig. 3-3 Screen addressing example

A typical application of a user-created display is shown in Fig. 3-4 which features an interconnection diagram.




```
1000 Start:          DIM A$[100]
1010                 Addr=706
1020                 REMOTE Addr
1030                 RESTORE Radio
1040                 GOSUB Displaypage
1050                 STOP
1060 Radio:          DATA 11,0,HAND PORTABLE TEST
1070                 DATA 11,1,##################
1080                 DATA 0,4,"                              RADIO: ABC1234"
1090                 DATA 0,5,"  <@@@@@@@@@@@@@@@@@@^"
1100                 DATA 0,6,"  ?<@@@@@@@@^<<<<<<<<?"
1110                 DATA 0,7,"  ??         ?<<<<<<<<?   PLEASE CONNECT"
1120                 DATA 0,8,"  ??         ?<<<<<<<<?"
1130                 DATA 0,9,"  ??  2955  ?<<<<<<< ?   RADIO AS SHOWN"
1140                 DATA 0,10,"  ½?         ?<<<  << Ò"
1150                 DATA 0,11,"  ½?         ?<<       Ò"
1160                 DATA 0,12,"  ??         ?<<< O <<?"
1170                 DATA 0,13,"  ?>@@@@@@@@_<<<   <<?   THEN PRESS ANY"
1180                 DATA 0,14,"  ?    <<<            ?"
1190                 DATA 0,15,"  ?  **<<<**    ?   KEY TO CONTINUE"
1200                 DATA 0,16,"  >  ¦¦¦¦¦¦¦¦¦{{¦¦{  _"
1210                 DATA 0,17,"   >_          }}  >_"
1220                 DATA 0,18,"               }~  ~"
1230                 DATA 0,19,"               }}  >@@@@@@^ ANTENNA"
1240                 DATA 0,20,"               }          } #######"
1250                 DATA 0,21,"               }}         <`¦¦^"
1260                 DATA 0,22,"               }}   MIC  ?@@@?"
1270                 DATA 0,23,"               }>@@@@@@@@?@@@?"
1280                 DATA 0,24,"               }          ?@@@?"
1290                 DATA 0,25,"               } SPEAKER ?   ?"
1300                 DATA 0,26,"               >@@@@@@@@@?* *?"
1310                 DATA 0,27,"                          ?   ?"
1320                 DATA 0,28,"                          ?   ?"
1330                 DATA 0,29,"                          ?   ?"
1340                 DATA 0,30,"                          >@@@_"
1350                 DATA -10,0,0
1360                 !
1370                 !
1380                 !
1390 Displaypage:    OUTPUT Addr USING "K";"HD1ESCS"              ! CLEAR SCREEN
1400                 READ X,Y,A$
1410                 IF X<0 THEN RETURN                           ! PAGE COMPLETE?
1420                 OUTPUT Addr USING "K";"WR";X;",";Y;",";A$
1430                 GOTO 1400
1440                 !
1450                 !
1460                 !
1470                 END
```

Fig. 3–4 Display example

Appendix 1

COMMAND CODES

Command code	Data	Function
AC		As AC DC key - AC selected
AG		As AF GEN key
AM		As AM % key
BC		As SCOPE/BAR key - BAR charts selected
BP		Sound a tone in the loudspeaker
BU		As dB key - dBμV selected
BX	<n>, <m>	On screen, draw soft key box to arrow the key where <n> is the box position and <m> is the box length (number of characters)
CD		CLEAR DTMF RECEIVE DATA
CM	0 or 1	NORMAL 2955A or 2955 EMULATION (under any menu)
CR		Select CW for DIRECTIONAL POWER METER (under any menu)
CS		Screen clear
CT		CLEAR DTMF SEND DATA
DB		As dB key - dB selected
DC		As AC DC key - DC selected
DE		As DELETE key
DI		As Δ INCR key
DM		As dBm key
DS		Screen output disable
DT		DIRECTIONAL POWER METER display disable when Directional Power Head is fitted
DU	<m>, <n1>, <n2> ...	Poke bytes <n1>, <n2> etc (up to a terminator) into memory locations starting at <m> (maximum of 64 bytes)
DV		VARIABLE control disable
DX		As DUPLEX TEST key
EM		Set instrument to EMF measurement (under any menu)
ER		Send (when next addressed to talk) the code for the last error detected
ES		Screen output enable
ET		DIRECTIONAL POWER METER display enable when Directional Power Head is fitted
EV		VARIABLE control enable
EX		Send <EOI><ETX> when the output buffer is empty
FD		As FREQ ↓ key
FI	0, 1, 2 or 3	As BAND PASS and LOW PASS keys - 0.3 to 3.4 kHz BP, 15/50 kHz LP, 300 Hz or external selected
FM		As FM key
FR		As FREQ key
FU		As FREQ ↑ key
HD	0 or 1	As HOLD DISPLAY key - off or on
HP		As HELP key
HZ		As Hz μV key - Hz selected
IF	0 or 1	TRANSMITTER MONITOR mode IF filter 12 kHz or 180 kHz
IM	0 or 1	TRANSMITTER MONITOR mode RF IMAGE UPPER or LOWER
IP	0, 1 or 2	As SELECT ↔ key - BNC RF IN/OUT, N RF IN/OUT or

Command code	Data	Function
KZ		As kHz mV key - kHz selected
LC		Letters mixed case to be used in terminator strings (e.g. dBm)
LD		As LEVEL ↓ key
LF		Send <EOI> with <LF>
LL	1 or 0	LOCK or UN-LOCK modulation or AF levels together
LS		LOAD DTMF tones sequence
LU		As LEVEL ↑ key
LV		As LEVEL key
MD	0 or 1	As ON OFF key - all modulation off or modulation 1 and external external modulation on (for compatibility with 2955 MOD ON-OFF)
MV		As kHz mV key - mV selected
MZ		As MHz V key - MHz selected
NF	0 or 1	As ON OFF key - off or on
OD	0 to F	Send single DTMF digits
PA	1, 2, 3 or 4	Set POCSAG ADDRESS
PB		Sound a tone in the loudspeaker
PD		Set instrument to PD measurement (under any menu)
PE	<m>	Send (when next addressed to talk) the data at memory location <m>
PG		Purge output buffer
PM		As ΦM RAD key
PO	<m>, <n>	Poke byte <n> into memory location <m>
PP	1 to 32	Create POCSAG ERRORS
PR		Select PEP for DIRECTIONAL POWER METER (under any menu)
PS	1, 2, 3 or 4	Set POCSAG MESSAGE
PT	1 to 32	Delete POCSAG ERRORS
RC		As RECALL key

Command code	Data	Function
RD	<n>	Send (when next addressed to talk) the measurement or setting as specified in <n> as follows:-
	1	RF counter FREQUENCY measurement
	2	RF POWER measurement
	3	MODULATION FREQUENCY measurement
	4	MODULATION LEVEL voltage measurement
	5	AF counter FREQUENCY measurement
	6	AF LEVEL voltage measurement
	7	RECEIVER SINAD, S/N or DISTORTION measurement
	8	TRANSMITTER SINAD, S/N or DISTORTION measurement
	9	MODULATION LEVEL peak positive measurement
	10	MODULATION LEVEL trough negative measurement
	11	DIRECTIONAL POWER METER FORWARD POWER measurement
	12	DIRECTIONAL POWER METER REVERSE POWER measurement
	13	DIRECTIONAL POWER METER VSWR measurement
	14	SEQUENTIAL TONES, TONE 1) FREQUENCY measurement
	15	SEQUENTIAL TONES, TONE 2) or TONE number and
	16	SEQUENTIAL TONES, TONE 3) ERRORS measurement as
	17	SEQUENTIAL TONES, TONE 4) determined by using
	18	SEQUENTIAL TONES, TONE 5) TF or TE
	19	SEQUENTIAL TONES, TONE 6) (Table 2-3)
	20	SEQUENTIAL TONES, TONE 7)
	21	SEQUENTIAL TONES, TONE 8)
	22	SEQUENTIAL TONES, TONE 9)
	23	SEQUENTIAL TONES, TONE 10)
	24	SEQUENTIAL TONES, TONE 11)
	25	SEQUENTIAL TONES, current PAGE number
	26	SEQUENTIAL TONES, standard setting
	27	RF generator FREQUENCY setting
	28	RF generator LEVEL setting
	29	AF GENERATOR FREQUENCY setting
	30	AF GENERATOR LEVEL setting
	31	MODULATION FREQUENCY setting
	32	MODULATION LEVEL setting
	33	RF FREQUENCY INCREMENT setting
	34	RF LEVEL INCREMENT setting
	35	AF GENERATOR FREQUENCY INCREMENT setting
	36	AF GENERATOR LEVEL INCREMENT setting
	37	MODULATION FREQUENCY INCREMENT setting
	38	MODULATION LEVEL INCREMENT setting
	39	Whole page of measurements and settings (TRANSMITTER TEST, RECEIVER TEST and DUPLEX tests only)
	100	AF GENERATOR 2 FREQUENCY setting
	101	AF GENERATOR 2 LEVEL setting
	102	MODULATION 2 FREQUENCY setting
	103	MODULATION 2 LEVEL setting
	104	AF LEVEL measurement in dBV or dBr
	105	MODULATION LEVEL measurement in dB
	106	MODULATION LEVEL default setting
	107	SEQUENTIAL TONES DURATION in ms setting
	108	POCSAG RIC setting
	109	DTMF RECEIVE DATA

Command code	Data	Function
RG		As RF GEN key
RI	7 digits	Set POCSAG RIC
RP		As REP key
RS		Screen restore
RT		As RX=TX FREQ key
RX		As RX TEST key
SC		As SCOPE/BAR key - SCOPE selected
SD		Store disable and POke disable (under any menu)
SE		Store enable and POke enable (under any menu)
SK		Send (when next addressed to talk) an ASCII code for the character of the last key pressed - see Fig. 2-3
SM		As SET MOD key
SN	0, 1, 2 or 3	As SINAD S/N and DIST'N ON-OFF keys - off, default (SINAD or S/N), non-default (S/N or SINAD) or DISTORTION
SP		On screen, suppress annunciators REM, ADR, SRQ and LCL
SQ	0, 1 or 2	Service request inhibit, error only or enable
SS		SEND DTMF tones sequence
SV		Send (when next addressed to talk) a data string which, when sent back to the instrument, restores current settings
ST		As STORE key
SW		As SINGLE key
TD		As ↔ key
TE		SEQUENTIAL TONES, select TONE number and ERROR measurements for use with RD 14 to 24 (Table 2-4)
TF		SEQUENTIAL TONES, select FREQUENCY measurements for use with RD 14 to 24 (Table 2-4)
TM	0 or 1	As TX MON ON-OFF key off or on
TN		As TONES key
TU		As →← key
TX		As TX TEST key
UC		Letters upper case only to be used in terminator strings (e.g. DBM)
UV		As Hz µV key - µV selected
VD		As ↑↓ key
VL		As MHz V key - V selected
VN		Send (when next addressed to talk) the software version number
VU		As ↓↑ key
WR	0 to 39, 0 to 31, <string>	Write <string> starting at given column and given row
WS	0, 1, 2 or 3	Wave SHAPE - SINE, SQUARE, TRIANGLE or SAW TOOTH
XA		As TX TEST key as soft key
XB		As RX TEST key as soft key
XC		As DUPLEX TEST key as soft key
XD		As TONES key as soft key
XE		As TX MON ON-OFF key as soft key
XF		As SCOPE/BAR key as soft key
XG		As HOLD key as soft key
XH		As HELP key as soft key

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